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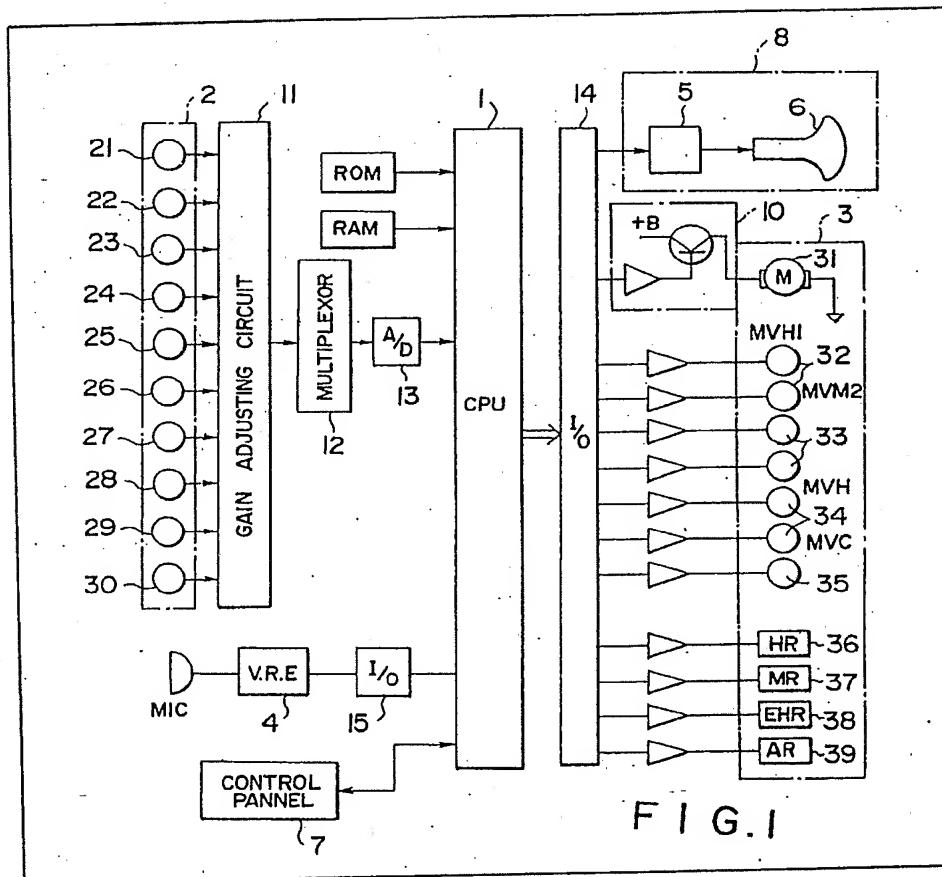
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(54) Apparatus for controlling air conditioner by voice

(57) In an apparatus for controlling an air conditioner through a computer, various controls are automatically effected by voice but not only by manual operation. Specific contents of voices are predetermined in

accordance with the objects of controls, the contents of the voices are read by a voice recognizing equipment (4), whereby recirculated-fresh air switching and blow-out outlet switching are effected by a microprocessor (1) in accordance with the contents thus read, thereby eliminating necessity for manual operation.



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FIG. I

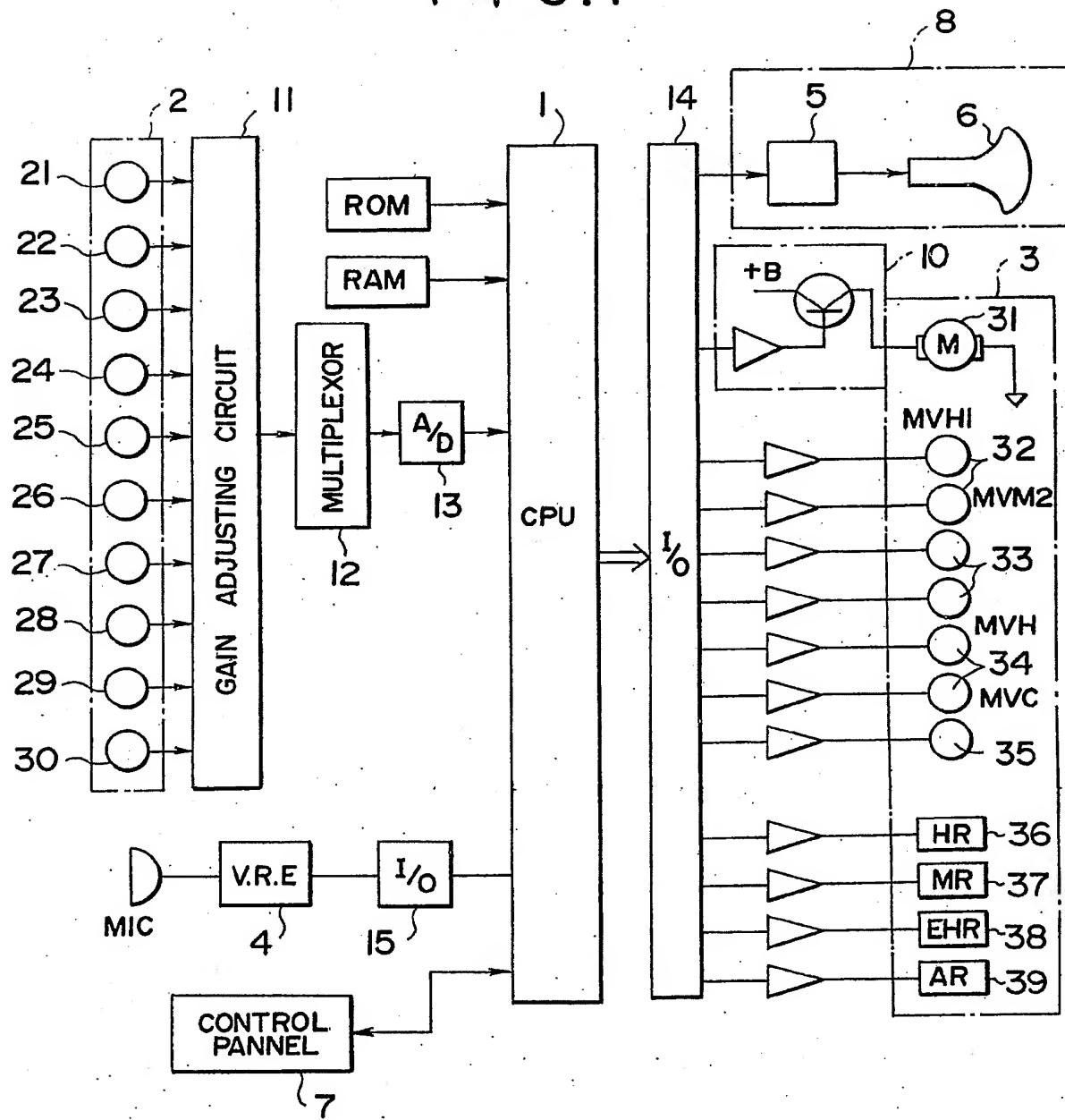
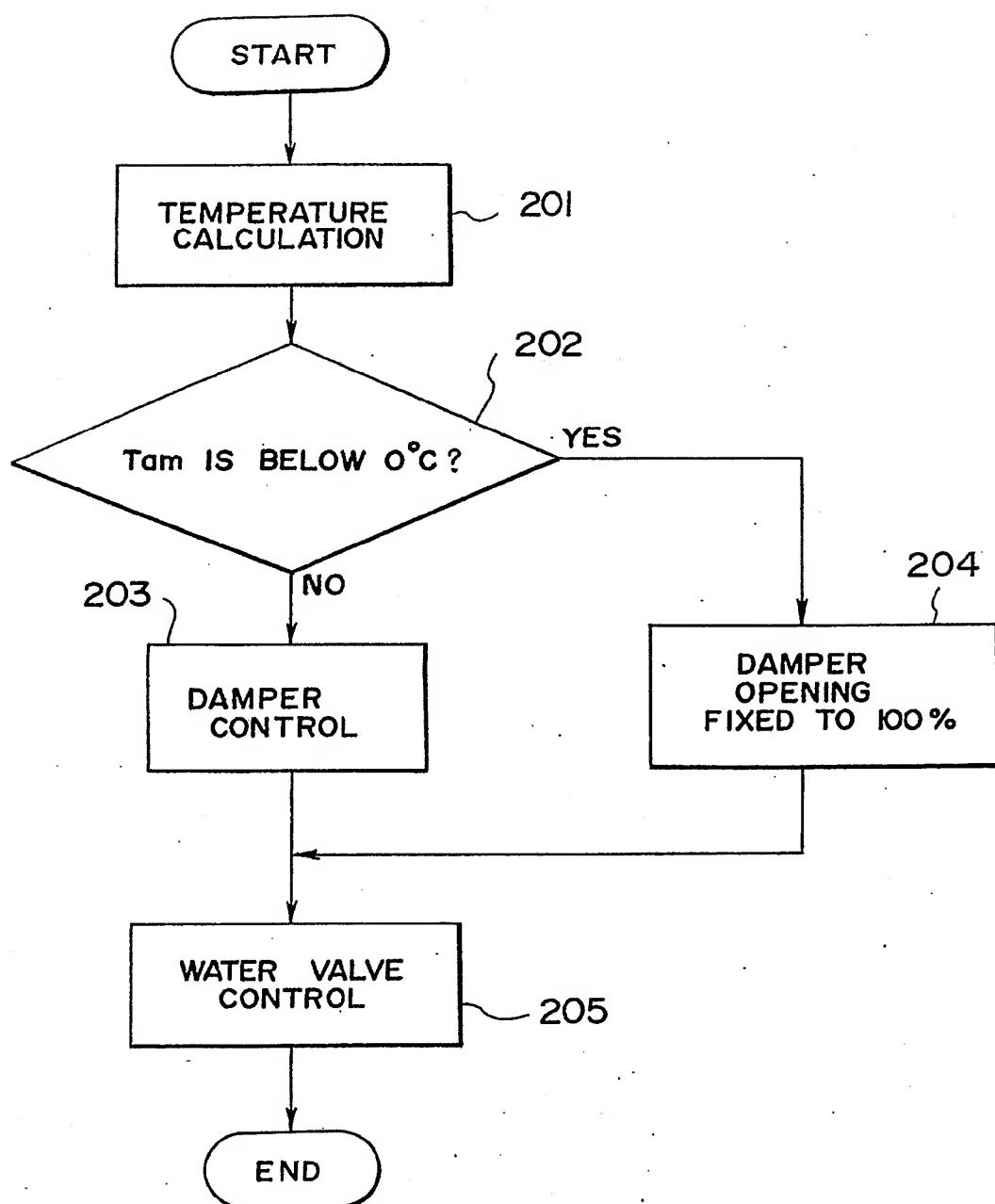


FIG. 2



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FIG. 3

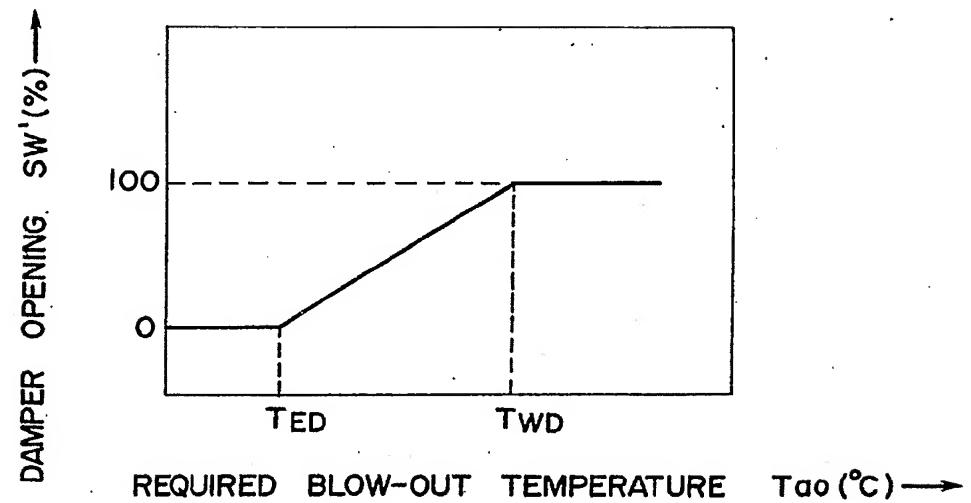


FIG. 4

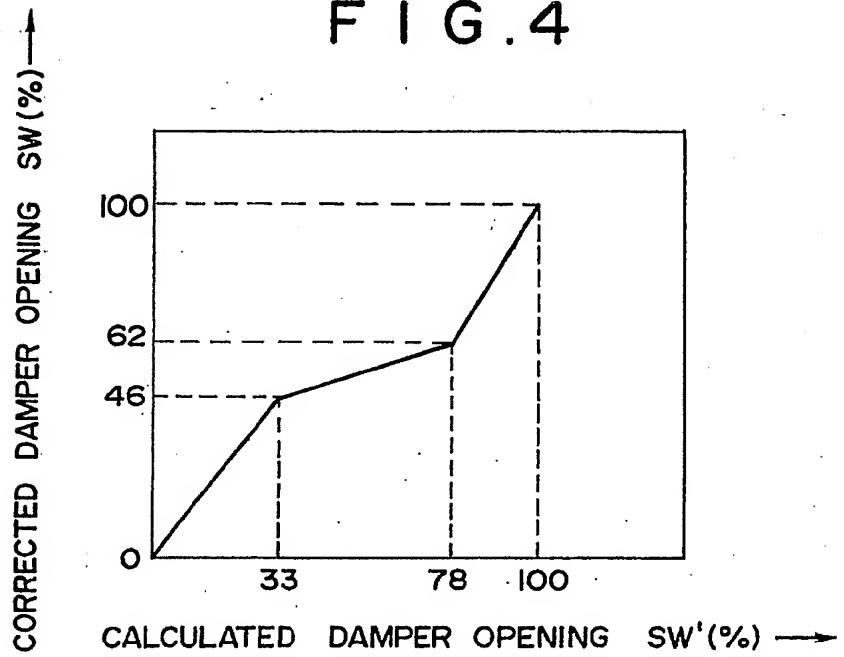


FIG. 5

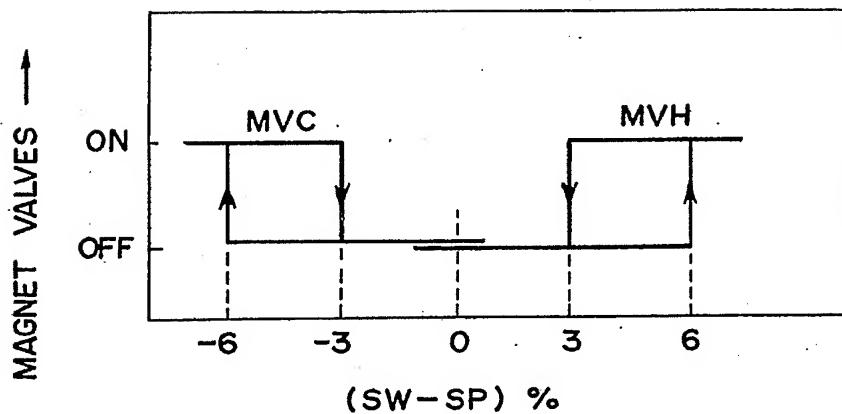


FIG. 6

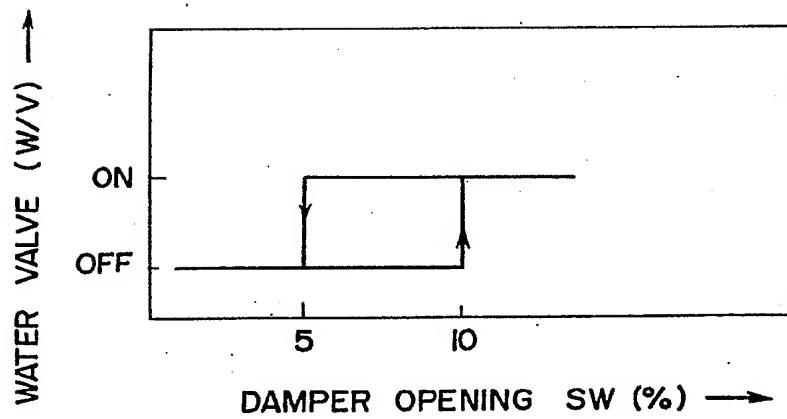
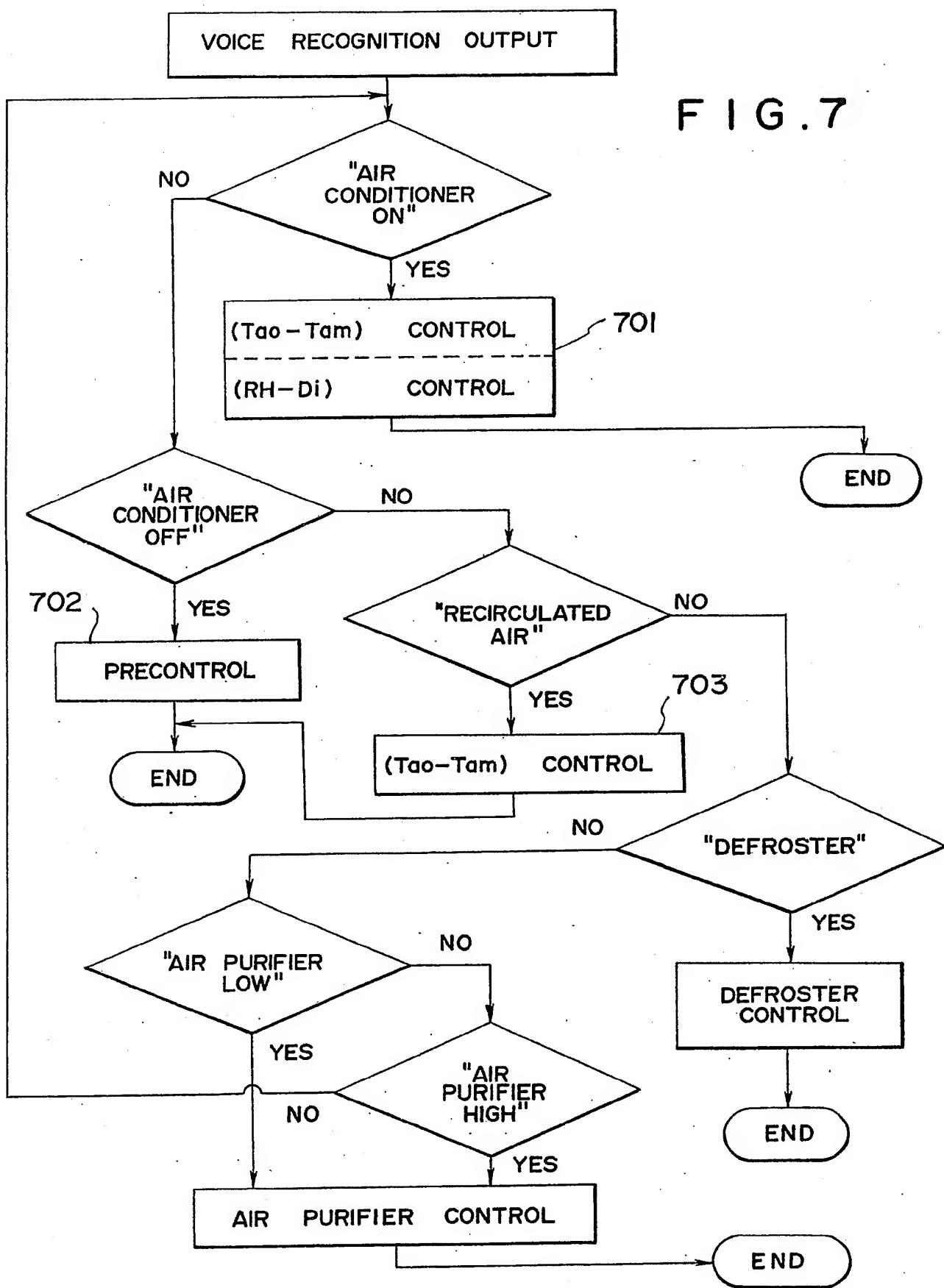
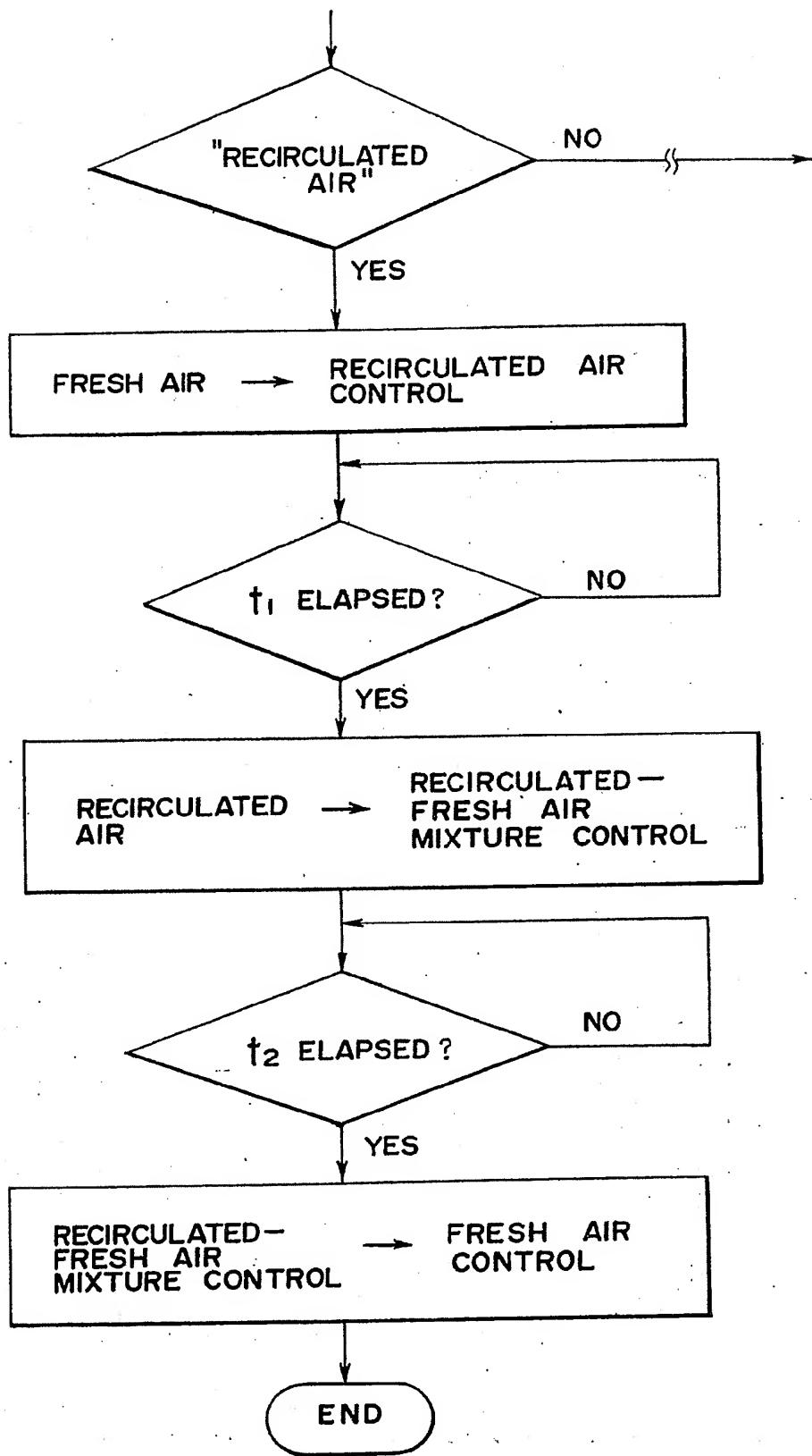


FIG. 7



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FIG. 8



SPECIFICATION

Apparatus for controlling air conditioner by voice

This invention relates to apparatuses for controlling air conditioners, and particularly to an apparatus for controlling an air conditioner, which is suitable for carrying out a variety of modes by use 5 of a computer and a voice recognizing equipment.

5

Vehicles such as motor cars may be provided with air conditioners, with which ventilation, air cooling and the like may be performed as necessary. In the conventional air conditioners, all of the various operations such as selection of modes, regulation of air flow, control of air cooling and warming and the like have been relied on the manual operation of an operator. Because of this, not only the 10 manual operation has been cumbersome and but also there has been a possibility that safe driving is interfered with the operation made by the operator.

10

The present invention has as its object the provision of an apparatus for controlling an air conditioner by voice, wherein switching of recirculated-fresh airs and switching of blow-out outlets can be effected.

15

The present invention contemplates that, when voices having meanings the switching between recirculated and fresh airs or the switching of the blow-out outlets are pronounced, these voices are decoded by a voice recognizing equipment to control a computer program, thereby enabling to effect the switching between recirculated and fresh airs or the switching of blow-out outlets.

15

An embodiment of the invention will now be described by way of example and with reference to 20 the accompanying drawings, in which:—

20

Fig. 1 is a block diagram shown one embodiment of the present invention;

Fig. 2 is a process flow chart showing the fundamental control according to the present invention;

Fig. 3 is a damper opening characteristic curve diagram to required blow-out temperatures;

Fig. 4 is an explanatory view showing the damper opening correction;

25

Fig. 5 is an explanatory view showing the control on a magnet valve;

Fig. 6 is an explanatory view showing the control on a water valve;

Fig. 7 is a process flow chart showing the control by voice according to the present invention; and

25

Fig. 8 is a process chart showing the internal air control.

Fig. 1 is a block diagram showing one embodiment of the present invention.

30

A central processing unit (hereinafter referred to as "CPU") 1 as a medium is connected thereto with a sensor 2, a component 3 being controlled, a voice recognizing equipment 4, further, with ROM (READ ONLY MEMORY) and RAM (RANDOM ACCESS MEMORY) as memories, and still further, with a multi-display device 8 (including a CRT controller 5 and a color CRT 6) for displaying various data.

30

A sensor unit 2 includes an internal temperature sensor 21, an external temperature sensor 22, a

35

water temperature sensor 23, an evaporator outlet sensor 24, a potentiometer 25 for indicating an opening of air mix damper, a sunlight sensor 26, a humidity sensor 27, a condensation sensor 28 and an air contamination sensor 29. Since these sensors have dispersions in detecting sensibility, output and the like, gains of these sensors are adjusted in a gain adjusting circuit 11. As a result, characteristics of outputs from the gain adjusting circuit 11 inputted to an A/D converter 13 at the succeeding step

40 through a multiplexor 12 are turned to be uniform in the analogue level. The A/D converter 13 outputs a digital signal corresponding to an inputted analogue voltage to CPU 1.

40

The component 3 being controlled includes a blower motor 31 driven by a driving circuit 10, a valve 32 for switching the blow-out openings, a valve for switching the recirculated air to the fresh air and vice versa, a valve 34 for an A/M damper, a water valve 35, a heater relay (HR) 36, a magnet clutch

45

45 relay (MR) 37, an Ex-Hi relay (EHR) 38 and an air purifier control relay (AR) 39. The thus included parts are driven through drivers or exclusive amplifiers, and all the connections therebetween are controlled by CPU 1 through an I/O (input/output circuit) 14. Similarly, the multi-display device 8 is driven by CPU 1 through I/O 14. All the controls studied in the present invention are effected centered around this core of CPU 1.

45

50 Description will hereunder be given of the details of controls effected by CPU 1 as described above with reference to the flow charts.

50

Firstly, A/M (Air Mixture) damper opening calculation as being a fundamental control in the air conditioner control, A/M damper control and basic temperature control are processed by CPU 1 in accordance with the flow chart shown in Fig. 2. In step 201, the internal air temperature T_r , ambient air

55 temperature T_{am} and sunlight temperature ST are taken in so as to correct a set value of room temperature. Namely, the set value T_{set} stored in the memory is corrected by the ambient air temperature T_{am} and the sunlight temperature ST as follows:

55

$$T_{set} = K_{set} - K_{a1} (T_{am} - 10) - K_{a2} \cdot ST \dots \dots (1)$$

where K_{a1} and K_{a2} are constants and the unit of the sunlight temperature is $Kcal/m^2 \cdot min$.

60 Subsequently, a required blow-out temperature T_{ao} is calculated through an equation (2) shown below based on the set temperature T_{set} calculated through the equation (1).

60

$$Tao = Kset \cdot Tset - Kam \cdot Tam - Kr \cdot Tr - Ks \cdot ST + C \dots (2)$$

where $Kset$, Kam , Kr , Ks and C are constants.

Further, the damper opening SW' is obtained based on the required blow-out temperature Tao ($^{\circ}C$) as shown in Fig. 3, the damper opening SW is set to an opening of 100% based on a corrected water temperature T_{WD} ($^{\circ}C$) to be described hereunder, and a corrected evaporator outlet temperature Ted is set to an opening of 0% of the damper opening SW . In this case, Twd and Ted are calculated through equations shown below.

$$Twd = (Tw - Ted) \phi + Ted \dots (3)$$

$$Ted = Te + 3 \dots (4)$$

10 where Tw is water temperature, ϕ a constant and Te the evaporator outlet temperature.

However, when DEF of the air conditioner and dampers of EXT-HI are "OFF" and the ambient air temperature Tam is below $0^{\circ}C$, the opening of the A/M damper is fixed to 100% (the highest temperature range) (Steps 202 and 204). When it is judged that the abovedescribed conditions are not fulfilled, the damper opening correcting process commences. Namely, the damper opening obtained in accordance with Fig. 3 is corrected in accordance to Fig. 4. Further magnet valves 34 (MVC, MVH) shown in Fig. 1 are controlled to obtain the characteristics shown in Fig. 5, so that the damper opening SW' obtained in accordance with Fig. 4 can coincide with the actual A/M damper opening SP . When the characteristics shown in Fig. 5 are obtained, the process terminates.

15 Additionally, the water valve WV is controlled so as to obtain the characteristics shown in Fig. 6. This process corresponds to the process in step 205 shown in Fig. 2. The water valve WV is on-off 20 operated within the range of the thus set damper opening. In an example shown in Fig. 6, the water valve WV is controlled within the range of 5 to 10%. Description will hereunder be given of compressor control.

25 The compressor control is stopped by an external control signal (given by a panel switch of a control panel 7 or the like) and a voice signal when a heater relay 36 is "OFF" and the air conditioner is "OFF". In operation, the compressor is controlled by four modes shown below.

- (i) control by the ambient air temperature Tam
- (ii) control by $(Tao - Tam)$
- (iii) control by $(Tao - Te)$

30 (iv) control by relative humidity RH and degree of resentment index $DI(RH - DI)$

For example, the abovedescribed controls may be based on data given by the control panel 7 (a magnetic card, a magnetic tape or the like), or based on data stored in ROM and selected by the panel switch of the control panel 7.

35 The control by the ambient air temperature Tam mentioned in (i) above is carried out such that the compressor is turned "ON" when the ambient air temperature exceeds a predetermined value, and the compressor is turned "OFF" when the ambient air temperature is lowered to below the predetermined value, taking a control mode relied only on the ambient air temperature Tam . The control by $(Tao - Tam)$ mentioned in (ii) above is carried out such that a difference in temperature between the recirculated air and the fresh air is set at a predetermined value, referenced from which the compressor 40 is on-off operated. The control by $(Tao - Te)$ mentioned in (iii) above is carried out such that, for example, when a difference in temperature between the recirculated air and the fresh air is $1^{\circ}C$, the compressor is turned "ON", and, when the difference is $3^{\circ}C$, the compressor is turned "OFF". The control by $(RH - DI)$ mentioned in (iv) above is carried out such that, for example, when the abovedescribed difference is 5%, the compressor is turned "ON" and, when the difference is 0%, the compressor is turned "OFF".

45 In addition to the abovedescribed on-off control of the air conditioner, the controls of the air conditioner include recirculated air-fresh air switching control, blow-out outlet control, air flow control, condensation control and air purifier control.

50 Out of the abovedescribed controls, reset of the blow-out temperature according to the present invention will hereunder be described in detail.

Fig. 7 shows a flow chart of process by voices.

55 As shown in Fig. 1, a voice received by MIC is signal-processed by the voice recognition equipment 4. The voice recognition equipment 4 passes a voice input through a band pass filter, not shown, divided into a plurality of frequency bands, and outputs thus filtered are successively and selectively outputted through the multiplexer. These outputs (analogue signals) from the multiplexer are A/D converted into digital signals, outputted to I/O 15 and transferred to CPU 1. The voice signals are desirably encoded only by changing the written-in contents, however, in the embodiment of the present invention, only six types thereof are exemplified. In addition, normally, control modes (for example, a manual operation by use of a panel switch) having priority over the voice control are present, and further, control modes (controls by use of various sensors and external components) being lower in the 60 order of priority than the voice control are present.

In the voice control to be described hereunder, all of the controls having priority over the voice control are in non-operation conditions, and only the voice control is functioning and in a stand-by condition. Additionally, the respective voices are constantly, sequentially decoded by the soft ware of CPU 1 to be successively read.

5 When the user requires the air conditioning, he pronounces a predetermined word such as "Air conditioner on". Upon catching this voice, CPU 1 commences (Tao — Tam) control or (RH-Di) control out of the above-described air conditioner controls, i.e. brings about the normal control condition (step 701). Simultaneously with the commencement of function of this mode, a letter "A or C" is displayed in a CRT display. Additionally, an indication is made in an A/C switch of the control panel 7. In this case, the user 10 selects either (Tao — Tam) control or (RH-Di) control through the magnetic card, magnetic tape, panel switch or the like. 10

To stop the air conditioner in operation, the user pronounces a predetermined term such as "Air conditioner off." In this case, CPU 1 moves to a precontrol in step 702. The precontrol functions only when the "A/C" switch of the control panel is manually turned off or "Air conditioner off" takes places, 15 and has the following two control contents.

(a) Turning the heater relay 36 "OFF", and turning the compressor "OFF"
 (b) Performing A/M damper control, water-valve control and blow-out outlet control in normal manners

When a term "Recirculated air" is pronounced, a recirculated-fresh air switching control process commences to drive the valve 33, so that "the recirculated air" condition is brought about. In this case, 20 the air conditioner is controlled by (Tao — Tam) control (step 703). In this case, letters "REC" is indicated in the CRT display 6. This recirculated-fresh air control is switched from FRS (fresh air) mode to REC (recirculated air) condition by an action of the recirculated-fresh air switching valve 33 when the term "recirculated air" is pronounced. This recirculated air mode is continued for a predetermined period of time, and then, gradually restored to the original fresh air mode. Fig. 8 shows this process. 25

When a term "Defroster" is pronounced, a blow-out outlet control process commences, letters "DEF" are indicated on the CRT display 6, and the blow-out outlet switching valve 33 is driven by MVM1 = ON and MVM2 = OFF, whereby blow-out outlets are brought into a "DEF" (defrosting) condition. In this case, upon lapse of a predetermined time (for example, a time of 6 min set on a soft ware timer according to the program) in the "DEF" condition of the blow-out outlets, the blow-out outlets are 30 returned to the original condition (any of the conditions VENT, B/L and HEAT). Additionally, the condition VENT, B/L (BI-LEVEL) or HEAT is obtainable by controlling MVM (magnet valves) 1,2 (33) as shown in table below. 30

MVM CONDITION OF BLOW-OUT OUTLET	VENT	HEAT	B/L	DEF
MVM 1	OFF	ON	OFF	ON
MVM 2	OFF	ON	ON	OFF

Next, the pronouncing of the term "Air purifier low" or "Air purifier high" enables the air purifier control mode to be performed. This air purifier control is applied in the case the air in the compartment is contaminated by smoking and the like, the ventilation is effected by controlling the air purifier control relay 39. Used in this case air contamination sensors 29 including a smoke sensor, a gas sensor and the like. When the term "Air purifier low" is pronounced, a blower motor of the air purifier is transferred from a Hi mode (high speed rotation) or on OFF mode to a Lo mode (low speed rotation). When the term "Air purifier high" is pronounced, the blower motor of the air purifier is transferred to a Hi mode from other modes. Durations of these voice controlled modes are controlled through the software timer by CPU 1, and, for example, a specified mode is maintained only for five minutes, and then, restored to the original control mode. 40

As has been described above, according to the present invention, the recirculated-fresh air switching control and the blow-out outlet switching control in the air conditioner control can be effected 45 by voice in addition to the manual operation. As a consequence, even during running condition of the vehicle, the air conditioner can be controlled without letting hands go off the steering wheel, thereby enabling to improve the safety driving and facilitate control.

It should be apparent to those skilled in the art that the above-described embodiment represents 50 but one of the many possible specific embodiments of the present invention. Numerous and varied other embodiments can be devised by those skilled in the art without departing from the spirit and scope of the present invention.

CLAIMS

1. Apparatus for controlling an air conditioner by voice, comprising:
a voice recognizing equipment for reading contents of a voice corresponding to data for changing
blow-out temperature of said air conditioner, converting said voice into a digital and outputting same;
5 and
a central processing unit for controlling said air conditioner to recirculated air mode or blow-out
mode for a predetermined period of time in response to an output from said voice recognizing
equipment, when the manual operation is released. 5

10 2. Apparatus for controlling an air conditioner by voice as set forth in claim 1, the contents of said
voices are terms indicating the recirculated air. 10

10 3. Apparatus for controlling an air conditioner as set forth in claim 1, wherein the contents of said
voice is a term indicating "Defroster".

15 4. Apparatus for controlling an air conditioner as set forth in claim 1, wherein said recirculated-
fresh air switching, upon having been switched over to "Defroster", is continued for a predetermined
15 period of time. 15

15 5. Apparatus for controlling an air conditioner as set forth in claim 1, wherein said blow-out outlet
switching, upon having been switched over to "Recirculated air", is continued for a predetermined
period of time.

20 6. Apparatus for controlling an air conditioner as set forth in claim 1, wherein, upon the lapse of a
predetermined period of time in recirculated air mode, the recirculated air mode is gradually returned to
the fresh air mode. 20

20 7. Apparatus for controlling an air conditioner as set forth in claim 1, wherein the contents of said
voices are indicated in a CRT display.

25 8. Apparatus for controlling an air conditioner as set forth in claim 1, wherein the contents of said
voices are indicated in a control panel. 25

25 9. Apparatus for controlling an air conditioner by voice, substantially as hereinbefore described
with reference to the accompanying drawings.

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25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained